HYPORHAMPHUS AUSTRALIS X *HY. MELANOCHIR*, A HYBRID HALFBEAK (HEMIRAMPHIDAE) FROM AUSTRALIA

The purpose of this note is to report the first known occurrence of hybridization in the family Hemiramphidae. According to Schwartz (1972) it is also the first known hybrid within the order Synentognathi (or suborder Exocoetoidei according to some recent classifications).

Three species of sea garfishes (halfbeaks) of the genus *Hyporhamphus* occur in Australia-New Zealand waters (Collette[1]): *Hy. ihi* Phillipps, the New Zealand garfish or piper; *Hy. australis* (Steindachner), the eastern sea garfish; and *Hy. melanochir* (Valenciennes), the southern sea garfish. The three species are very closely related but differ in numbers of gill rakers, vertebrae, dorsal and anal fin rays, relative length of the upper and lower jaw, and placement of the pelvic fins. They are almost completely allopatric but the ranges of *Hy. australis* and *Hy. melanochir* overlap at Eden in southern New South Wales near the Victoria border.

During a year's study at the Australian Mu-

[1] Collette, B. B. The garfishes (Hemiramphidae) of Australia and New Zealand. Unpublished manuscript.

TABLE 1.—Numbers of fin rays, gill rakers, and vertebrae in *Hyporhamphus australis*, *Hy. melanochir*, and a hybrid between the two species.

	Dorsal rays						Anal rays					
	15	16	17	18	*N*	$\bar{x}$	17	18	19	20	*N*	$\bar{x}$
Hy. australis												
New South Wales	29	68	10		107	15.82	12	63	24	2	101	18.16
Eden, N.S.W.		2			2	16		2			2	18
Hybrid-Eden			1		1	17			1		1	19
Hy. melanochir												
Eden			1		1	17			1		1	19
Victoria	1	28	33	2	64	16.56		19	37	8	64	18.83

	First arch gill rakers														
	27	28	29	30	31	32	33	34	35	36	37	38	39	*N*	$\bar{x}$
Hy. australis															
New South Wales					3	6	9	16	23	28	10	6	2	103	35.10
Eden, N.S.W.									1	--	1			2	36
Hybrid-Eden						1								1	32
Hy. melanochir															
Eden			1											1	29
Victoria	1	2	11	15	14	11	6							60	30.60

	Second arch gill rakers														
	21	22	23	24	25	26	27	28	29	30	31	32	33	*N*	$\bar{x}$
Hy. australis															
New South Wales			1	--	7	6	10	16	16	19	17	6	2	100	28.91
Eden, N.S.W.								1	--	--	--	1		2	30
Hybrid-Eden								1						1	28
Hy. melanochir															
Eden		1												1	22
Victoria	1	5	10	17	20	4	2							59	24.19

	Total vertebrae								
	55	56	57	58	59	60	61	*N*	$\bar{x}$
Hy. australis									
New South Wales		7	33	10				50	57.06
Eden, N.S.W.			1	1				2	57.5
Hybrid-Eden					1			1	59
Hy. melanochir									
Eden						1		1	60
Victoria				6	3	2		11	58.64

seum in 1969-70, I visited the Sydney fish market almost every week to obtain fishes. Origin of specimens from throughout New South Wales was determined by identifying the fishery cooperative which offered each box of fish for auction.

On 8 April 1970, I selected, more or less at random, four sea garfishes from several boxes of large specimens from Eden, New South Wales. (These specimens, all females, have been catalogued into the U.S. National Museum collections: USNM 207518-292 mm standard length; 207519-269 mm; 207520-280 mm; and 207521-264 mm). The smallest of the four specimens (USNM 207521) was separated from the other three on the basis of its low gill-raker counts (29 on the first arch, 22 on the second). This count is characteristic of the Victorian population of *Hy. melanochir* (Table 1). Two of the other three specimens (USNM 207518-9) had gill-raker counts typical for *Hy. australis*. The fourth specimen (USNM 207521) had gill-raker counts intermediate between *Hy. melanochir* and *Hy. australis*.

The small specimen of *Hy. melanochir* had 17 dorsal and 19 anal rays in agreement with the modes for the Victorian population (Table 1). The pair of *Hy. australis* had 16 dorsal and 18 anal rays in agreement with the modes for that species. The fourth specimen, like the *Hy. melanochir*, had counts of 17 dorsal and 19 anal rays.

Intermediacy in gill-raker count suggested that the fourth specimen might be a hybrid between *Hy. australis* and *Hy. melanochir;* hence, pigment comparisons were made prior to preservation. There was more yellow on the anterior edge of the anal fin in the small *Hy. melanochir* than in the two *Hy. australis*. The fourth specimen was intermediate. Pigmentation in the pectoral fin was most prominent in the *Hy. melanochir* and the fourth specimen where the melanophores formed a spot distally in the fin. The pigment was distributed all over the fin in the two *Hy. australis*. Scattered small melanophores gave a mottled appearance to the lateral line along the body in the *Hy. melanochir*. This pigment was absent in both *Hy. australis*. A trace of pigment was present in the fourth specimen.

The three larger specimens had a more prominent ridge in the middle of the upper jaw than did the small *Hy. melanochir*. The upper jaw of the *Hy. melanochir* was distinctly shorter than its width (width/length ratio 1.33), in agreement with 35 Victorian specimens of the species (0.92-1.49, mean 1.16). The two *Hy. australis* had the upper jaw about as long as wide (ratios 0.99 and 0.96) as do 32 other *Hy. australis* (0.86-1.29, mean 1.00). The fourth specimen was intermediate (ratio 1.23) between Eden specimens of the two species but within the usual range of *Hy. melanochir* (Figure 1).

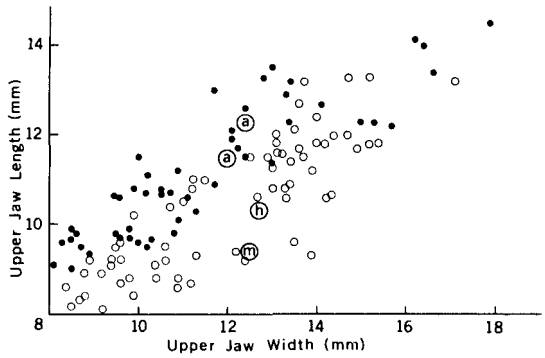

FIGURE 1.—Relationship of upper jaw length to upper jaw width in two species of Australian halfbeaks. Open circles indicate *Hyporhamphus melanochir*; dots *Hy. australis*. Four specimens from Eden, New South Wales indicated by letters: a for *Hy. australis*; m for *Hy. melanochir*; and h for *Hy. australis* × *melanochir*.

Otoliths were extracted from all four specimens while fresh and were examined shortly thereafter by otolith specialist John E. Fitch, who was told only that the four sets of otoliths had come from some Australian halfbeaks. He concluded that two sets (the *Hy. australis*) were of one species, one set (the small *Hy. melanochir*) was of a second species, and the fourth set was intermediate. *Hy. australis* has a much longer (relative to height) sagitta than *Hy. melanochir* (Figure 2). Length divided by height averages (left and right sagittae measured) 1.91 and 1.93 for the two *Hy. australis*, 1.43 for the *Hy. melanochir*, and 1.72 for the fourth specimen. *Hy. australis* has a more pointed rostrum than *Hy. melanochir*, and has a vertical groove near the rostrum on the external side that is

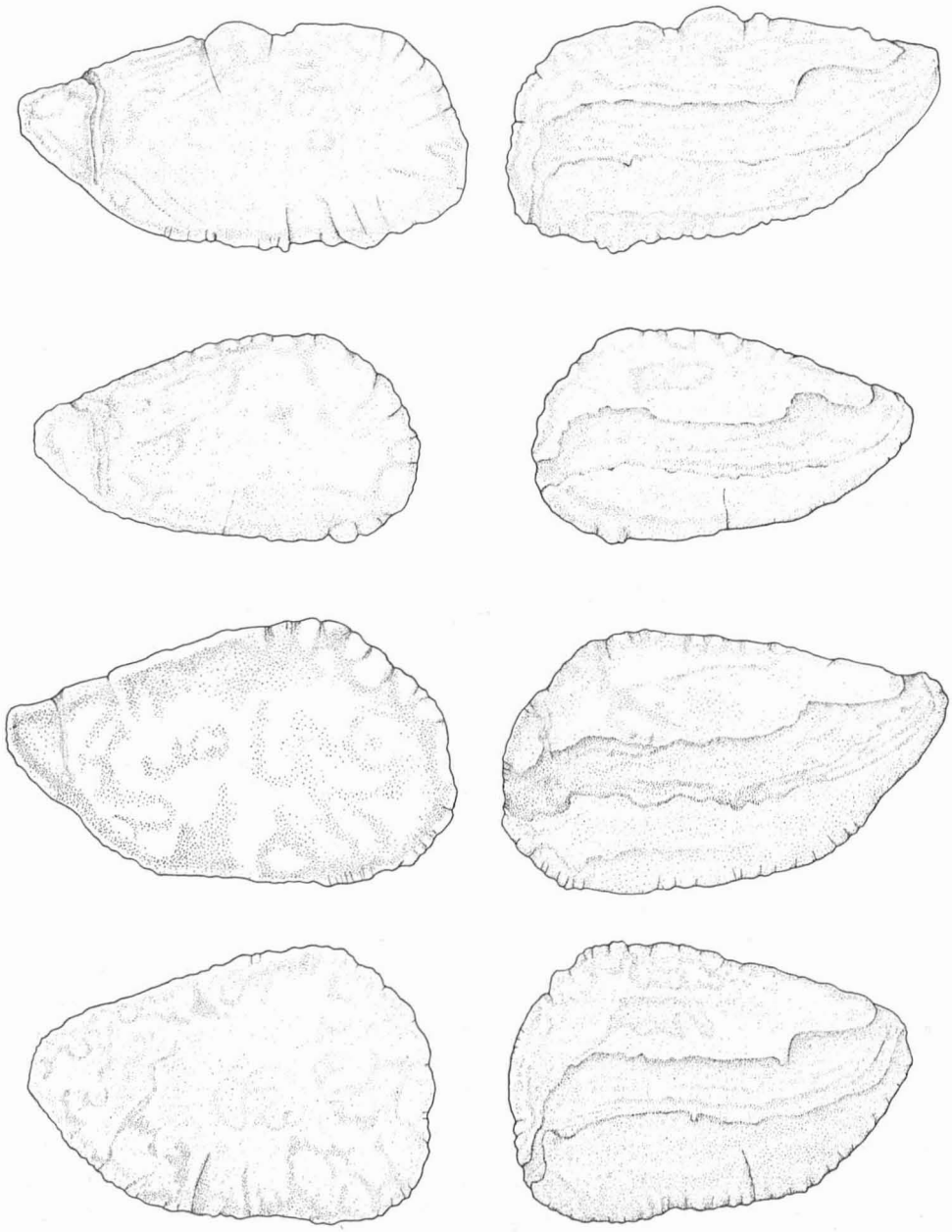

FIGURE 2.—Otoliths (sagittae) of two species of halfbeaks from Eden, New South Wales, Australia. Outer surface on left, inner surface, with sulcus, on right. Top to bottom: *Hyporhamphus australis*, 292 mm SL (standard length); *Hy. australis*, 269 mm SL; *Hy. australis* × *melanochir*, 280 mm SL; and *Hy. melanochir* 264 mm SL.

absent in *Hy. melanochir*. The fourth specimen is intermediate with a faint rostral groove.

Vertebral counts also indicate hybridization. The small *Hy. melanochir* had 60 vertebrae, at the high end of the range for nine Victorian specimens (Table 1). The two *Hy. australis* had 57 and 58 vertebrae, comparing well with 50 New South Wales specimens. The fourth specimen was intermediate with 59 vertebrae.

Based on its intermediacy in gill-raker and vertebral counts, pigmentation, upper jaw length, and otolith structure, I conclude that the fourth specimen is a hybrid between *Hy. australis* and *Hy. melanochir*. The two species are essentially allopatric and show character displacement as their ranges approach, that is, the Victoria population of *Hy. melanochir* differs more from the neighboring New South Wales population of *Hy. australis* than do populations of *Hy. melanochir* from further west, in South Australia and Western Australia (Collette, see footnote 1).

I thank Daniel M. Cohen and Robert H. Gibbs, Jr., for reviewing the manuscript, John E. Fitch for examining the otoliths, Frank J. Schwartz for checking his manuscript on fish hybrids, R. Budd for permitting access to the Sydney fish market, and Keiko Moore for preparing the illustrations.

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CONTRIBUTION ON THE SPAWNING OF *AUXIS* SP. (PISCES, SCOMBRIDAE) IN THE ATLANTIC OCEAN

The frigate mackerel (*Auxis* sp.) are apparently among the most abundant scombrids in the tropical Atlantic Ocean. They form a substantial part of the diet of skipjack tuna, *Katsuwonus pelamis*; yellowfin tuna, *Thunnus albacares* (Dragovich, 1970a); and bluefin tuna, *T. thynnus* (Dragovich, 1970b); and, therefore, it is important to understand their life history and their role in the trophodynamics of tropical ocean ecosystems. We report on the examination of ovaries from 76 frigate mackerel collected from the eastern and western tropical Atlantic, and off Cape Hatteras, N.C. (Figure 1).

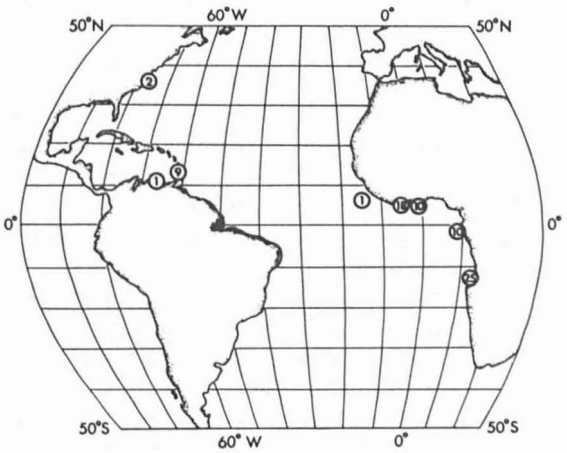

FIGURE 1.—Location and number of *Auxis* sp. captured (in circle) from which ovaries were examined.

The genus *Auxis* may be composed of two species, *A. thazard* (Lacépède) and *A. rochei* (Risso). We were not able to assign the specimens in our study to either species because the published diagnostic characters were not reliable for species identification. More taxonomic work is needed on the genus (William J. Richards, Southeast Fisheries Center, Miami Laboratory,

[1] Contribution No. 222, Southeast Fisheries Center, Miami Laboratory, National Marine Fisheries Service.